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10/009,910	12/12/2001	Makoto Iida	81839.0107	7347

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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 06/24/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/009,910	Applicant(s) IIDA ET AL.
	Examiner Matthew J Song	Art Unit 1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 4/15/2004.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-10 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-10 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claim 9 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 9 recites, "in which oxygen precipitation nuclei of $1x10^9$" in line 4. There is no support for oxygen precipitation nuclei. The instant specification merely teaches a BMD density of $1x10^9$, note page 13 of the specification.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various

claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iida et al (US 5,968,264) in view of Fujikawa (US 6,277,501).

Iida et al discloses a method of forming a silicon wafer with an N region formed over the entire surface by pulling a crystal from a silicon melt in a Czochralski method at a pulling rate, V, ranging between 0.55-0.58 mm/min and a G ranging from 42.0-45.0 °C/cm from the center to the edge of the silicon ingot, this reads on applicant's controlling V/G because V and G are controlled, therefore the ratio is inherently controlled (Example 1 and 2). Iida et al also discloses in order to establish the N region over the entire cross section of a crystal, a highly precisely control must be carried out. Also note that the entire reference has been incorporated into the basis of the rejection.

Iida et al does not disclose the silicon single crystal is pulled while doping with carbon.

In a method of forming a silicon wafer, note entire reference, Fujikawa teaches growing a silicon single crystal while controlling the oxygen concentration in the range of $12x10^{17}$-$18x10^{17}$ atoms/cm^3 and controlling the carbon concentration in the range of $0.3x10^{16}$-$2.5x10^{16}$ atoms/cm^3 (col 9, ln 1-67), where $2.5x10^{16}$ atoms/cm^3 of carbon approximately corresponds to 0.5 ppma (col 5, ln 1-67). Fujikawa also teaches annealing a wafer, containing specified amounts of

oxygen and carbon, is annealed at 600-900°C for at least more than 15 minutes to achieve a BMD of over $3x10^8/cm^3$ (col 11, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Iida et al with Fujikawa to promote precipitation of oxygen, thereby producing an epi-wafer without an expensive EG treatment (col 6, ln 1-67 and col 7, ln 1-67).

The combination of Iida et al and Fujikawa et al is silent to the silicon single crystal being pulled at a rate greater than the rate of pulling a silicon single crystal with no carbon doping. Iida et al teaches through the adequate adjustment of the pulling rate, the N region can be formed over the entire crystal cross section (col 5, ln 10-15), which is a teaching that pulling rate is a result effective variable for forming a N-region. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida et al and Fujikawa et al by optimizing the pulling rate to obtain a pulling rate greater than the rate of pulling a silicon single crystal with no carbon doping conducting routine experimentation of a result effective variable.

Referring to claim 5, the combination of Iida et al and Fujikawa teaches annealing at 600-900°C, overlapping ranges are held to be obvious (MPEP 2144.05).

5. Claims 2, 6, 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iida et al (5,968,264) in view of Fujikawa (US 6,277,501) as applied to claim 1 above, and further in view of Tamatsuka et al (US 6,162,708).

The combination of Iida et al and Fujikawa teaches all of the limitations of claim 2, as discussed previously in claim 1, except the silicon single crystal is doped with nitrogen.

In a method of forming an epitaxial silicon wafer, note entire reference, Tamatsuka et al teaches a silicon single crystal doped with nitrogen in the range of $1x10^{10}$ to $5x10^{15}$ atoms/cm^3 and an interstitial oxygen concentration in the single crystal ingot is 18 ppma or less (col 2, ln 1-67). Tamatsuka et al also teaches annealing at 900°C (col 8, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida et al and Fujikawa with Tamatsuka et al because a silicon single crystal wafer produced by doping nitrogen during growth of the silicon crystal ingot has a high gettering capability, growth of grown in defects incorporated can be suppressed and density of oxide precipitates can be increased (col 6, ln 1-67).

Referring to claim 6, the combination of Iida, Fujikawa and Tamatsuka et al teaches annealing at 600-900°C. Overlapping ranges are held to be obvious.

Referring to claim 9, it is noted that claim 9 is a product claim, which recites process limitations. The patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113). Therefore, the product taught by the combination of Iida, Fujikawa and Tamatsuka et al reads on the instantly claimed silicon wafer because the product limitations are taught by the combination of Iida, Fujikawa and Tamatsuka et al. The combination of Iida, Fujikawa and Tamatsuka et al teaches annealing to achieve a BMD of over $3x10^8/cm^3$ this reads on applicants oxygen precipitation nuclei because applicants teach a BMD density, note page 13 of the specification. Overlapping ranges are held to be obvious (MPEP 2144.05).

6. Claims 3 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iida et al (US 5,968,264) in view of Fujikawa (US 6,277,501) as applied to claim 1 above, and further in view of Hourai et al (US 5,954,873).

The combination of Iida et al and Fujikawa teaches all of the limitations of claim 3, as discussed previously, except controlling V/G within a range of 0.183-0.177 mm^2/ K min.

Hourai et al discloses a V/G ratio of 0.183-0.177 mm^2/K min (Fig 2), where dislocation clusters form through the entire wafer, this reads applicant's N-region, where wafers are formed from a silicon single crystal ingot manufactured by the Czochralski method with careful control of the pulling rate and temperature gradient permit a crystal to be formed that is free of Oxidation induced stacking fault rings and other defects (Abstract). Hourai et al also teaches V and G are important parameters for controlling the diameter of an OSF ring (col 4, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida et al and Fujikawa with Hourai et al because a larger V/G allows the crystal to be pulled faster, thereby increasing production.

7. Claims 4 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iida et al (US 5,968,264) in view of Fujikawa (US 6,277,501) and Tamatsuka et al (US 6,162,708) as applied to claim 2 above, and further in view of Hourai et al (US 5,954,873).

The combination of Iida et al, Fujikawa and Tamatsuka et al teaches all of the limitations of claim 4, as discussed previously, except controlling V/G within a range of 0.183-0.177 mm^2/ K min.

Hourai et al discloses a V/G ratio of 0.183-0.177 mm^2/K min (Fig 2), where dislocation clusters form through the entire wafer, this reads applicant's N-region, where wafers are formed from a silicon single crystal ingot manufactured by the Czochralski method with careful control of the pulling rate and temperature gradient permit a crystal to be formed that is free of Oxidation induced stacking fault rings and other defects (Abstract). Hourai et al also teaches V and G are important parameters for controlling the diameter of an OSF ring (col 4, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Iida et al, Fujikawa and Hourai et al with Hourai et al because a larger V/G allows the crystal to be pulled faster, thereby increasing production.

8. Claims 1, 3, 5, 7 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hourai et al (US 5,954,873) in view of Fujikawa (US 6,277,501).

Hourai et al discloses a V/G ratio of 0.183-0.177 mm^2/K min (Fig 2), where dislocation clusters form through the entire wafer, this reads applicant's N-region, where wafers are formed from a silicon single crystal ingot manufactured by the Czochralski method with careful control of the pulling rate and temperature gradient permit a crystal to be formed that is free of Oxidation induced stacking fault rings and other defects (Abstract). Hourai et al also teaches V and G are important parameters for controlling the diameter of an OSF ring (col 4, ln 1-67). Also note the entire reference has been incorporated into the basis of the rejection.

Hourai et al does not disclose the silicon single crystal is pulled while doping with carbon

In a method of forming a silicon wafer, note entire reference, Fujikawa teaches growing a silicon single crystal while controlling the oxygen concentration in the range of $12x10^{17}$-$18x10^{17}$

atoms/cm^3 and controlling the carbon concentration in the range of $0.3x10^{16}$-$2.5x10^{16}$ atoms/cm^3 (col 9, ln 1-67), where $2.5x10^{16}$ atoms/cm^3 of carbon approximately corresponds to 0.5 ppma (col 5, ln 1-67). Fujikawa also teaches annealing a wafer, containing specified amounts of oxygen and carbon, is annealed at 600-900°C for at least more than 15 minutes to achieve a BMD of over $3x10^8$/cm^3 (col 11, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hourai et al with Fujikawa to promote precipitation of oxygen, thereby producing an epi-wafer without an expensive EG treatment (col 6, ln 1-67 and col 7, ln 1-67).

The combination of Hourai et al and Fujikawa et al is silent to the silicon single crystal being pulled at a rate greater than the rate of pulling a silicon single crystal with no carbon doping. Hourai et al teaches careful control of the pulling rate permits a crystal to be formed that is free of Oxidation induced stacking fault rings and other defects (Abstract), which is a teaching that pulling rate is a result effective variable for forming a N-region. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Hourai et al and Fujikawa et al by optimizing the pulling rate to obtain a pulling rate greater than the rate of pulling a silicon single crystal with no carbon doping conducting routine experimentation of a result effective variable.

Referring to claim 3, 5 and 7, the combination of Hourai et al and Fujikawa teaches a carbon concentration of 0.5 ppma and a V/G of 0.183-0.177 mm^2/K min and annealing at a temperature of 600-900°C. Overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 9, the combination of Hourai et al and Fujikawa teaches a wafer with dislocation clusters throughout the wafer pulled under a similar V/G condition, as applicant,

therefore this reads on applicant's N-region. And a carbon concentration of 0.5 ppma. Also, it is noted that claim 9 a product claim, which recites process limitations. The patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113). Therefore, the product taught by the combination of Hourai et al and Fujikawa et al reads on the instantly claimed silicon wafer because the product limitations are taught by the combination of Hourai et al and Fujikawa et al. The combination of Hourai et al and Fujikawa teaches annealing to achieve a BMD of over $3x10^8/cm^3$, this reads on applicant's oxygen precipitation nuclei because applicants teaches BMD density, note page 13 of the instant specification. Overlapping ranges are held to be obvious (MPEP 2144.05).

9. Claims 2, 4, 6, 8 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hourai et al (US 5,954,873) in view of Fujikawa (US 6,277,501) as applied to claim 1 above, and further in view of Tamatsuka et al (US 6,162,708).

The combination of Hourai et al and Fujikawa teaches all of the limitations of claim 2, as discussed previously in claim 1, except doping with nitrogen.

In a method of forming an epitaxial silicon wafer, note entire reference, Tamatsuka et al teaches a silicon single crystal doped with nitrogen in the range of $1x10^{10}$ to $5x10^{15}$ atoms/cm^3 and an interstitial oxygen concentration in the single crystal ingot is 18 ppma or less (col 2, ln 1-67). Tamatsuka et al also teaches annealing at 900°C (col 8, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Hourai et al and Fujikawa with Tamatsuka et al because a silicon single crystal wafer produced

by doping nitrogen during growth of the silicon crystal ingot has a high gettering capability, growth of grown in defects incorporated can be suppressed and density of oxide precipitates can be increased (col 6, ln 1-67).

Referring to claims 6 and 8, the combination of Hourai, Fujikawa and Tamatsuka teaches annealing at 600-900°C, overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 10, the combination of Hourai, Fujikawa and Tamatsuka teaches a nitrogen content of $1x10^{10}$-$1x10^{15}$ number/cm3, overlapping ranges are obvious.

10. Claims 1-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Asayama et al (US 6,641,888) in view of Iida et al (US 5,968,264) or Hourai et al (US 5,954,873).

Asayama et al teaches a silicon single crystal is doped with carbon and nitrogen and is sliced to from silicon wafers (Abstract). Asayama et al teaches a nitrogen concentration of $5x10^{13}$ atoms/cm^3 and a carbon concentration of $3x10^{16}$ atoms/cm^3 (Table 1 and Table 2). Overlapping ranges are held to be obvious (MPEP 2144.05). Asayama et al also teaches the wafers are heat treated at 1000°C (col 10, ln 30-40).

Asayama et al is silent to the silicon single crystal is pulled while controlling V/G to have an N-region over an entire plane of the crystal.

Iida et al discloses a method of forming a silicon wafer with an N region formed over the entire surface by pulling a crystal from a silicon melt in a Czochralski method at a pulling rate, V, ranging between 0.55-0.58 mm/min and a G ranging from 42.0-45.0 °C/cm from the center to the edge of the silicon ingot, this reads on applicant's controlling V/G because V and G are controlled, therefore the ratio is inherently controlled (Example 1 and 2). Iida et al also discloses

in order to establish the N region over the entire cross section of a crystal, a highly precisely control must be carried out. Also note that the entire reference has been incorporated into the basis of the rejection. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Asayama et al with Iida's controlling V/G to form a silicon ingot with a desirable N-region over the entire cross section ('264 col 5, ln 1-20).

Hourai et al discloses a V/G ratio of 0.183-0.177 mm^2/K min (Fig 2), where dislocation clusters form through the entire wafer, this reads applicant's N-region, where wafers are formed from a silicon single crystal ingot manufactured by the Czochralski method with careful control of the pulling rate and temperature gradient permit a crystal to be formed that is free of Oxidation induced stacking fault rings and other defects (Abstract). Hourai et al also teaches V and G are important parameters for controlling the diameter of an OSF ring (col 4, ln 1-67). Also note the entire reference has been incorporated into the basis of the rejection. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Asayama et al with Hourai's controlling V/G to form a silicon ingot with a desirable N-region over the entire cross section ('264 col 5, ln 1-20).

The combination of Asayama et al and Hourai et al or the combination of Asayama et al and Iida et al is silent to the silicon single crystal being pulled at a rate greater than the rate of pulling a silicon single crystal with no carbon doping. Iida et al teaches through the adequate adjustment of the pulling rate, the N region can be formed over the entire crystal cross section (col 5, ln 10-15), which is a teaching that pulling rate is a result effective variable for forming a N-region. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asayama et al and Hourai et al or the

combination of Asayama et al and Iida et al by optimizing the pulling rate to obtain a pulling rate greater than the rate of pulling a silicon single crystal with no carbon doping conducting routine experimentation of a result effective variable.

Referring to claims 9-10, it is noted that claim 9 is a product claim, which recites process limitations. The patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113). Therefore, the product taught by the combination of Asayama et al and Hourai et al or the combination of Asayama et al and Iida et al reads on the instantly claimed silicon wafer because the product limitations are taught by the combination of Asayama et al and Hourai et al or the combination of Asayama et al and Iida et al. The combination of Asayama et al and Hourai et al or the combination of Asayama et al and Iida et al is silent to the defect density if $1x10^9$ number/cm^3, however this is inherent because the combination of Asayama et al and Hourai et al or the combination of Asayama et al and Iida et al teaches a similar method of pulling a single crystal doped with similar amounts of dopants and annealing at a similar temperature, as applicants.

Response to Arguments

11. Applicant's arguments filed 4/15/2004 have been fully considered but they are not persuasive.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching,

suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Iida et al teaches a method of pulling a silicon single crystal and Fujikawa teaches a method of pulling a single crystal while doping with carbon to promote precipitation of oxygen, which is desirable. Therefore, the prior art does teach motivation to combine the pulling technique of Iida et al with Fujikawa's carbon doping.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references (pg 6). See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Iida et al is solely relied upon as a teaching of controlling the pulling rate and temperature gradient to form an N-region. Fujikawa teaches doping with carbon to promote precipitation.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). Fujikawa teaches a method of pulling a single crystal while doping with carbon to promote precipitation of oxygen, which is desirable. The motivation comes directly from the teachings of the prior art.

In response to applicant's argument that the prior art does not teach a pulling rate possible ot obtain a N-region shifts faster by doping with carbon, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). The combination of Iida et al and Fujikawa teaches doping a single crystal with carbon during pulling and controlling the pulling rate and temperature gradient to form an N-region. The increase in pulling rate would have been expected based on the teachings of Iida et al because the pulling rate is varied between 1.0 mm/mm and 0.4 mm/min to determine the optimum pulling rate for forming an N-region, note Example 1.

Applicants' argument that a person of ordinary skill in the art cannot derive the present invention from Iida in combination with Fujikawa and it is impossible to pullig a silicon single crystal at a rate greater than the rate of pulling a single crystal with no carbon doping is not persuasive because it is viewed as mere attorney argument, which lacks evidence. Iida et al teaches varying pulling speed between 1.0 mm/min and 0.4 mm/min to determine the optimum pulling speed for pulling an N-region, note col 14, ln 20-30. The pulling speed taught by applicant is 0.63-065 mm/min (page 8 of the remarks), which is within the pulling speed range taught by Iida et al; therefore the optimum pulling speed could be determined by routine experimentation.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the V/G value possible to obtain the N-region shifts by doping with carbon (pg 8)) are not recited in the rejected

claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Applicants' argument that the pulling rate to obtain the N-region is 0.52-0.54 mm/min is noted but is not found persuasive. Iida et al teaches the pulling rate is 0.52-0.54 mm/min for a specific embodiment and temperature gradient. Iida et al is not limited to this pulling speed, as suggested by applicants. Iida et al also teaches varying pulling speed between 1.0-0.4 mm/min and splitting the grown crystal longitudinally to observe variations in crystal defects to determine the optimum pulling speed for forming an N-region, note Example 1.

Applicants' arguments against claim 9 are noted but are not found persuasive. Applicants allege that the combination of doping, N-region and density of oxygen precipitation nuclei cannot be derived by the combination of the cited references. Each of the limitations are taught by the prior art; therefore the combination of the teachings of the prior teach all of the instantly claimed limitations. Annealing a wafer doping with carbon having an optimum pulling speed for growing an N-region will produce the density of oxygen precipitation claimed by applicants.

Applicants' arguments against the combination of Hourai et al and Fujikawa regarding motivation are noted but are not found persuasive, as discussed previously in the related Iida et al rejection above. The same arguments are applied in regards to the combination of Hourai et al and Fujikawa. Furthermore, Hourai et al teaches an V/G ratio of 0.20 and the V/G level does not rise above 0.20 mm^2/°C-min for the first 200 mm of the crystal (col 7, ln 49-65); therefore the combination of Hourai et al and Fujikawa inherently must teach a V/G ratio of 0.183-0.177 mm^2/K*min because the V/G must be passed to obtain the V/G ratio taught by Hourai et al.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Minami et al (US 6,517,632) teaches doping a silicon using a Czochralski method with carbon and nitrogen, note abstract.

Togashi et al (US 2003/0068502) claims growing a perfect silicon single crystal ingot and doping with nitrogen, note claims 4-5.

Tamatsuka et al (US 6,478,883) teaches doping a silicon single crystal growing by the Czochralski method with nitrogen (Abstract).

Tamatsuka (US 6,224,668) teaches doping a silicon single crystal growing by the Czochralski method with nitrogen (Abstract).

Iida et al (US 2003/0015131) is a pending application with a common assignee and claimed maintaining V/G ratio and doping with nitrogen, note claims 8-22.

Pyi (US 2003/0079677) teaches doping a silicon ingot with carbon (Abstract).

Kirscht et al (US 6,491,752) teaches co-doping a silicon ingot with carbon (Abstract).

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO

MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER